MULTIMEDIA UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2017/2018

PPP0101 PRINCIPLES OF PHYSICS

(Foundation in Information Technology)

5 MARCH 2018
2.30 P.M. – 4.30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages.
2. Answer all questions.
3. Write your answers in the Answer Booklet provided.
4. Show all relevant steps to obtain maximum marks.

QUESTION 1 (15 MARKS)

a) Consider the system shown in Figure Q1(a) below. Block A weighs 36.5 N, and block B weighs 20.5 N. Once block B is set into downward motion, it descends at a constant speed.

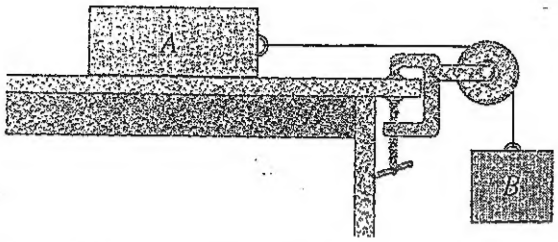

Figure Q1(a)

(i) Calculate the coefficient of kinetic friction between block A and the tabletop. [3.5 marks]

(ii) As block A moves to the right and block B moves downwards at a constant speed, a dog, also of weight 36.5 N, jumps on the top of block A. Calculate the acceleration of the system now (magnitude and direction). [4 marks]

b) A 10.0 g marble slides to the left at a speed of 0.40 m/s on the frictionless, horizontal surface and has a head-on, elastic collision with a larger 30.0 g marble sliding to the right at a speed of 0.20 m/s.

(i) Find the velocity of each marble (magnitude and direction) after the collision. [5 marks]

(ii) Calculate the impulse for each marble. Compare the values for each marble. [2.5 marks]

QUESTION 2 (10 MARKS)

a) A 2.20 kg mass on a spring has displacement as a function of time given by

$$x(t) = (7.40cm)\sin[(4.16rad/s)t - 2.42]$$

Calculate,

(i) the time for one complete vibration. [1 mark]

(ii) the spring constant of the spring. [1 mark]

(iii) the maximum speed of the mass. [1 mark]

(iv) the position, speed, and acceleration of mass at t = 1.0 s. [3 marks]

(v) the force on the mass at that time. [1 mark]

Continued...

b) Under Damped, Critically Damped, and Over Damped are three common cases of heavily damped systems. Explain briefly all the three cases. [3 marks]

QUESTION 3 (15 MARKS)

a) The graph of displacement against time and the graph of displacement against position of a travelling wave are shown in Figure Q3(a) and Q3(b) respectively.

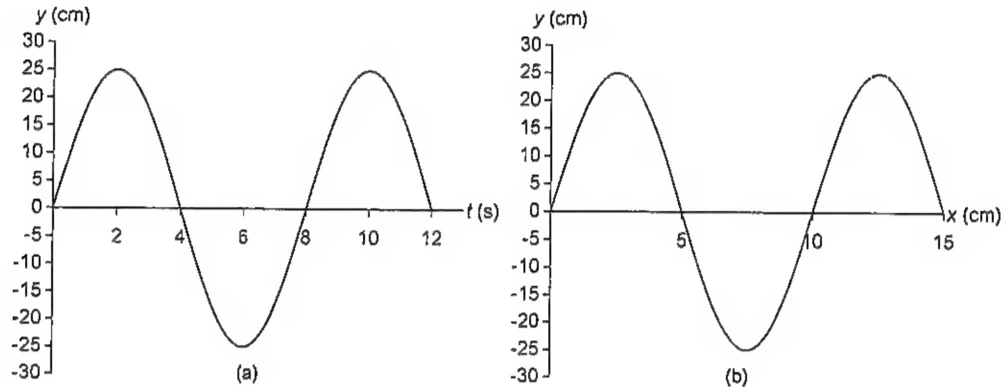

Figure Q3

(i) State the amplitude of the wave. [1 mark]

(ii) State the period of the wave. [1 mark]

(iii) State the wavelength of the wave. [1 mark]

(iv) Find the angular frequency of the wave. [2 marks]

(v) Find the wave number of the wave. [2 marks]

b) (i) Give one difference between loudness and pitch of sound. [2 marks]

(ii) Which one has a higher pitch: a dog's bark or a cat's meow? [1 mark]

c) The power of a sound source is 15 μW.

(i) What is the sound intensity 5 m from the source? [2 marks]

(ii) Your friend is standing at a distance of x from the source. Where should you stand so that the sound intensity you hear is one-third of your friend's? Express your answer in terms of x. [3 marks]

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QUESTION 4 (10 MARKS)

a) Figure Q4(a) below shows a laser beam that is directed to point A on a mirror. Being reflected by the mirror, the beam then hits point B.

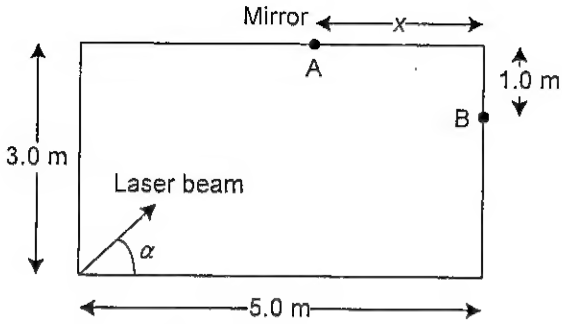

Figure Q4(a)

(i) Find the distance x. [2 marks]

(ii) Find the angle of incidence of the laser beam when it hits point A. [2 marks]

(iii) Find the angle α. [2 marks]

b) Two narrow slits 52 μm apart are illuminated with light of wavelength 500 nm.

(i) What is the angle of the second order bright fringe in degrees? [2 marks]

(ii) What is the distance of the screen from the slits if the second order bright fringe is 6 mm from the central maximum? [2 marks]

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APPENDIXES

LIST OF PHYSICAL CONSTANTS

Electron mass,	m_e	=	9.11×10^{-31} kg
Proton mass,	m_p	=	1.67×10^{-27} kg
Neutron mass,	m_n	=	1.67×10^{-27} kg
Magnitude of the electron charge,	e	=	1.602×10^{-19} C
Universal gravitational constant,	G	=	6.67×10^{-11} N.m^2 kg^{-2}
Universal gas constant,	R	=	8.314 J/K.mol
Hydrogen ground state,	E_o	=	13.6 eV
Boltzmann's constant,	k_B	=	1.38×10^{-23} J/K
Compton wavelength,	λ_c	=	2.426×10^{-12} m
Planck's constant,	h	=	6.63×10^{-34} J.s
		=	4.14×10^{-15} eV.s
Speed of light in vacuum,	c	=	3.0×10^{8} m/s
Rydberg constant,	R_H	=	1.097×10^{7} m^{-1}
Acceleration due to gravity,	g	=	9.81 m s^{-2}
1unified atomic mass unit,	1 u	=	931.5 MeV/c^2
		=	1.66×10^{-27} kg
1 electron volt,	1 eV	=	1.60×10^{-19} J
Avogadro's number,	N_A	=	6.023×10^{23} mol^{-1}
Threshold of intensity of hearing,	I_o	=	1.0×10^{-12} W m^{-2}
Coulomb constant,	$k = \frac{1}{4\pi\varepsilon_o}$	=	9.0×10^{9} Nm^2 C^{-2}
Permittivity of free space,	ε_o	=	8.85×10^{-12} C^2/N.m^{-2}
Permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ (T.m)/A
1 atmosphere pressure,	1 atm	=	1.0×10^{5} N/m^2
			1.0×10^{5} Pa
Earth: Mass,	M_E	=	5.97×10^{24} kg
Radius (mean),	R_E	=	6.38×10^{3} km
Moon: Mass,	M_M	=	7.35×10^{22} kg
Radius (mean),	R_M	=	1.74×10^{3} km
Sun: Mass,	M_S	=	1.99×10^{30} kg
Radius (mean),	R_S	=	6.96×10^{5} km
Earth-Sun distance (mean),		=	149.6×10^{6} km
Earth-Moon distance (mean),		=	384×10^{3} km

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LIST OF FORMULA

Differential Rule

$$y = kx^n$$

$$\frac{dy}{dx} = knx^{n-1}$$

Trigonometric Identity

$$\sin = \frac{opposite}{hypotenuse} \qquad \cos = \frac{adjacent}{hypotenuse} \qquad \tan = \frac{opposite}{adjacent}$$

$$\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$$

$$\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$$

NEWTONIAN MECHANICS

$$v = \frac{\Delta x}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad v = v_o + at \qquad x - x_o = v_o t + \frac{1}{2}at^2$$

$$v^2 = v_o^2 + 2a(x - x_o) \qquad x - x_o = \left(\frac{v_o + v}{2}\right)t$$

$$v = v_o + gt \qquad y - y_o = v_o t + \frac{1}{2}gt^2 \qquad v^2 = v_o^2 + 2g(y - y_o) \qquad y - y_o = \left(\frac{v_o + v}{2}\right)t$$

$$W = Fs\cos\theta \qquad W = mg \qquad \sum F = F_{net} = ma \qquad f_s \le \mu_S F_N$$

$$f_k = \mu_K F_N \qquad p = mv \qquad \sum F = \frac{\Delta p}{\Delta t}$$

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2 \qquad m_1u_1 + m_2u_2 = (m_1 + m_2)\,v \qquad P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$$

$$K = \frac{1}{2}mv^2 \qquad PE_s = \frac{1}{2}kx^2 \qquad F_s = -kx \qquad PE_G = mgy$$

$$v_{circular} = \frac{2\pi r}{T} \qquad a_c = \frac{v^2}{r} \qquad F_g = G\frac{m_1m_2}{r^2} \qquad U_g = -G\frac{m_1m_2}{r}$$

$$T^2 = K_s r^3 \qquad T_s = 2\pi\sqrt{\frac{m}{k}}$$

Spring with mass, $\omega = \sqrt{\frac{k}{m}}$

Simple pendulum, $\omega = \sqrt{\frac{g}{l}}$

$$T_p = 2\pi\sqrt{\frac{l}{g}} \qquad T = \frac{2\pi}{\omega} = \frac{1}{f}$$

Cosine Wave: $x = A\cos\omega t$, $v = -\omega A\sin\omega t$, $a = -\omega^2 A\cos\omega t$

Sine Wave: $x = A\sin\omega t$, $v = \omega A\cos\omega t$, $a = -\omega^2 A\sin\omega t$

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WAVES AND OPTICS

$v = f\lambda$ $\qquad \omega = 2\pi f$ $\qquad n = \dfrac{c}{v}$ $\qquad n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\sin\theta_c = \dfrac{n_2}{n_1}$ $\qquad \dfrac{1}{f} = \dfrac{1}{d_o} + \dfrac{1}{d_i}$ $\qquad M = -\dfrac{d_i}{d_o} = \dfrac{h_i}{h_o}$ $\qquad f = \dfrac{R}{2}$

$d\sin\theta_{\max} = m\lambda$ $\qquad a\sin\theta_{\min} = m\lambda$ $\qquad d\sin\theta_{\min} = (m+\frac{1}{2})\lambda$

$y_{bright} = \dfrac{m\lambda L}{d}$ $\qquad y_{dark} = (m+\frac{1}{2})\dfrac{\lambda L}{d}$ $\qquad I = \dfrac{P}{A}$ $\qquad \beta = 10\log_{10}\dfrac{I}{I_o}$

$f' = f\left(\dfrac{v \pm v_o}{v \mp v_s}\right)$ $\qquad y(x,t) = A\sin(kx \pm \omega t + \phi)$

Wave Type:

$y(x,t) = 2A\cos\left(\dfrac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$

$y(x,t) = 2A\sin kx \cos\omega t$

End of paper.